



National Aeronautics and
Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Improvements in Access to ASTER Data: Increasing the User Community

Michael Abrams, Bjorn Eng, Gary Geller: Jet Propulsion Laboratory, California
Institute of Technology, Pasadena, USA

Koki Iwao, National Institute of Advanced Industrial Science and Technology,
Tsukuba, Japan, iwao.koki@aist.go.jp

Masaru Fujita, Japan Space Systems, Tokyo, Japan, Fujita-
Masaru@jspacesystems.or.jp

Michael Ramsey, University of Pittsburgh, Pittsburgh, USA, mramsey@pitt.edu

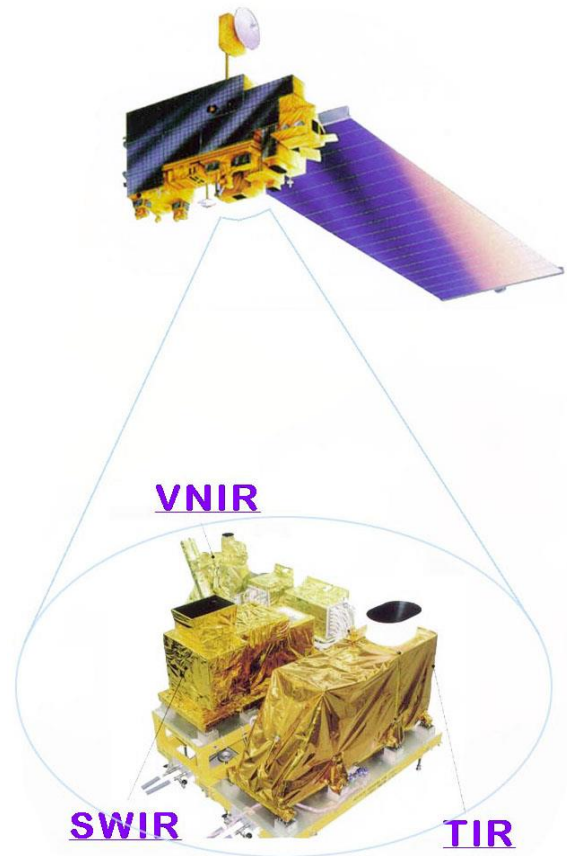
Introduction

- The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), on NASA's Terra satellite platform, is a collaborative project between Japan's Ministry of Economy, Trade and Industry, and U.S. NASA.
- ASTER data were expected to serve an established scientific user base, accustomed to similar data sets from Landsat and other multi-spectral imagers. While that community continues to be served, novel data products and acquisition approaches have increased the user base in several ways.

ASTER has a few distinct features that have contributed to this:

1. Three bands of High spatial resolution (for its time) Visible-Near InfraRed (VNIR) data
2. A backward viewing stereo band for Band 3 (VNIR)
3. Five bands of Thermal Infrared (TIR) data
4. Six bands of Shortwave Infrared (SWIR) data
5. An expedited data system for scheduling urgent acquisitions

AND 6. Creative Team members and associates who had good ideas and the energy and commitment to follow through with them.

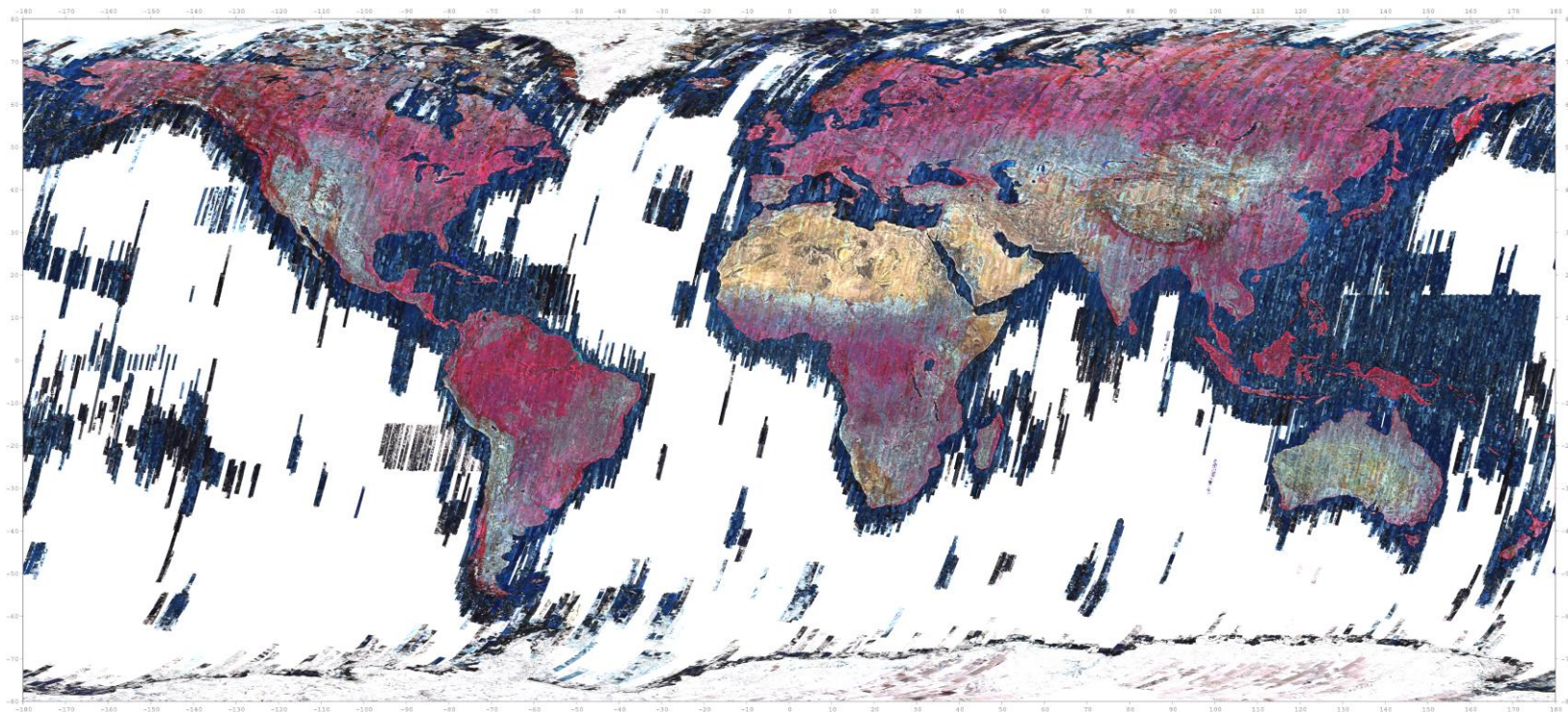


ASTER Scheduling in a nutshell

- The ASTER instrument is not always-on like many other sensors.
- ASTER is limited by downlink bandwidth to a roughly 8% duty cycle of acquisition.
- A sophisticated scheduling system was developed to select approximately 600 scenes to acquire each day, based on orbit, cloud-cover and the priority of targets. Large mapping tasks with low priority insure that the instrument is fully utilized.
- Users can submit proposals to have their targets observed.
- Daily acquisition schedules are transferred to Terra FOT for upload to the instrument.
- A limited capability to acquire Expedited data is in place for urgent requests made by either Japan or the US.

ASTER Scenes acquired – most recent mosaic

The scheduling works! More than 3.8 million scenes acquired.



TerraLook

- What was it like early in the Terra mission? There was **no Google Earth**. Satellite **data were expensive**. (In 2002, ASTER Level 1 scenes cost \$80 each and covered 60x60km. Landsat scenes were larger and more costly). **Analysis tools were complicated, expensive** or both. How could cash-strapped potential users get started?
- Gary Geller is an ASTER Team associate and remote sensing evangelist who wanted to help conservation organizations around the world make use of satellite data. Many of these potential users had severe budgetary constraints and could not afford expensive computers, satellite data, or sophisticated tools.
- Gary's answer was TerraLook. A package of expandable data collections and tools were developed, first released in 2007. It provided free tools and data that could be used on inexpensive hardware by local park managers and conservationists with no prior satellite data experience. Encroachment and land use changes over time could easily be studied and communicated to decision makers. The data were geolocated, full-scale, browse images in jpg format, and could be offered for free.

TerraLook

- ❑ Provides access to satellite data for busy people and the technologically disinterested
- ❑ Consists of two components
 1. Select and order system: allows users to select the specific images they want included in a collection (recent and historical images available)
 2. Toolkit: to view images, look for change, combine with overlays, and do other useful things

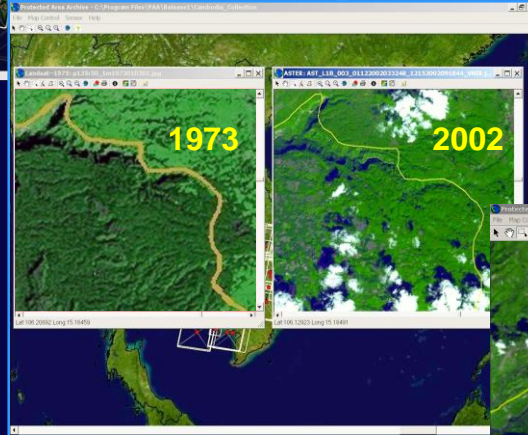
TerraLook

Find images

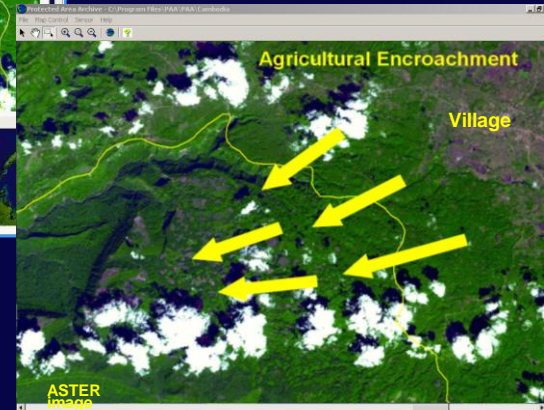


TerraLook provides easy access to images and tools to support decision making

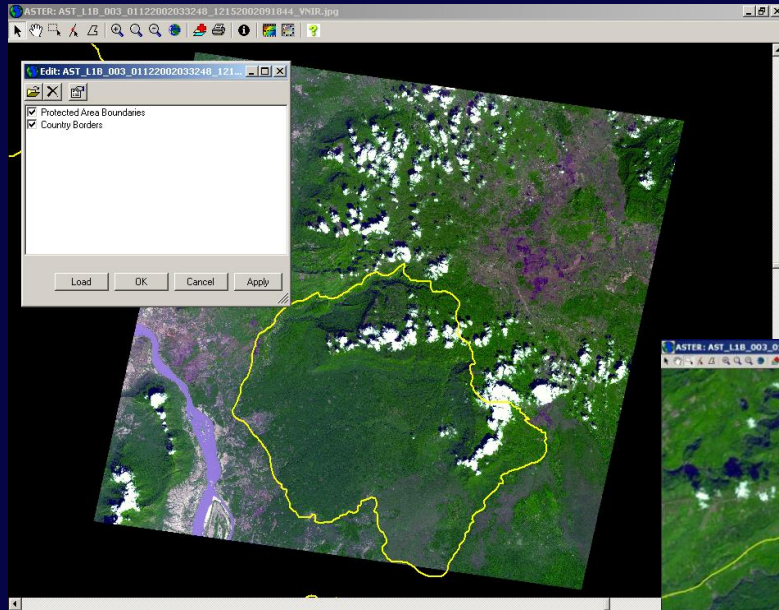
Display and compare



Tell the story



TerraLook: Simple Tools



Control overlays with
Overlay Manager

Measure area
and distance



TerraLook continued

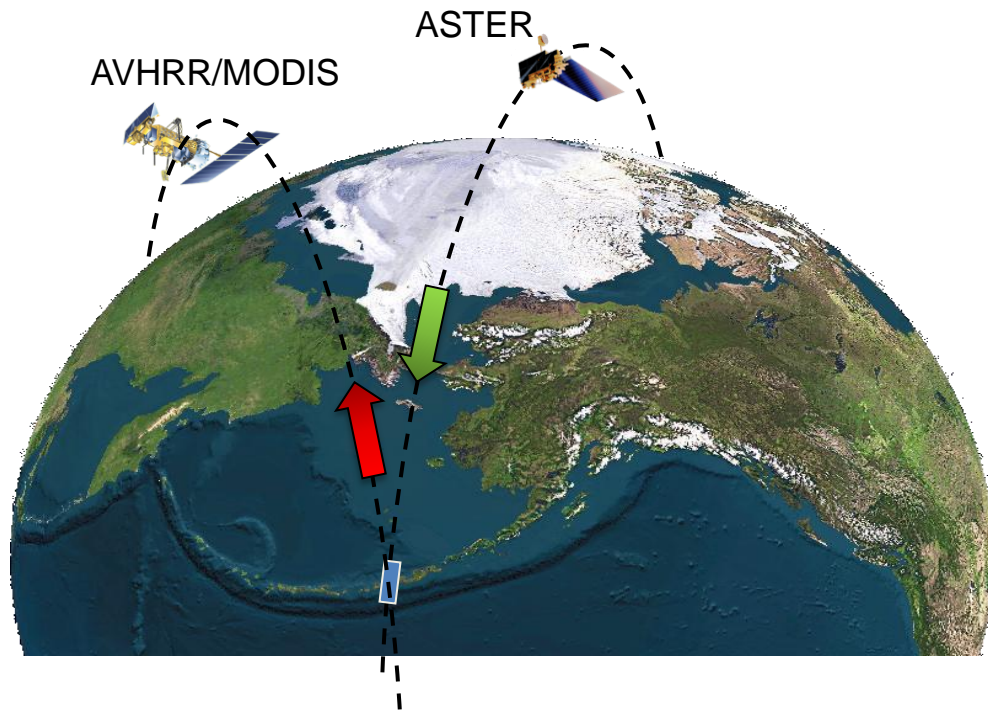
- TerraLook was made available for free to the global conservation community and classes were held at numerous Conservation and Protected Area Congresses worldwide.
- It has recently been decommissioned, but the spirit lives on in tools like LandsatLook and in the capabilities in Google Earth.
- Gary summed up the Initial response from experts:

“TerraLook was conceptualized and developed several years before GoogleEarth. And I remember how much resistance there was by some sectors to absorbing the idea of making images easily available. For example, the first time I gave a talk, at an American Association of Geographers meeting, the first question/comment was “What you are suggesting really scares the hell out of me!” The reason: Giving untrained people these images will lead to mistakes. Eventually, USGS got on board and made TerraLook operational. Of course, once Google Earth came out in 2015 those types of comments completely disappeared, and eventually USGS offered their own version of jpgs (LandsatLook). **So, we have watched an amazing transition from images being strictly held and used by scientists, to their widespread availability; they are the norm.**”

ASTER Volcano Activity Monitoring

❖ ASTER Urgent Request Protocol

- began in 2005 By M. Ramsey (U. Pittsburgh) as a way to improve the ASTER acquisitions frequency of active volcanic processes
- integrated system of universities, NASA, USGS, JSS
 - relies on detection by high temporal/ low spatial resolution sensors (*e.g.*, AVHRR, MODIS)
 - these detections trigger an ASTER rapid response scheduling through AESICS
 - can improve frequency to 1-3 days
 - average ~30-40 additional URP scenes per month
- URP includes MODVOLC (2012) and MIROVA (2018)
- **Data go immediately to Volcano Observatories**



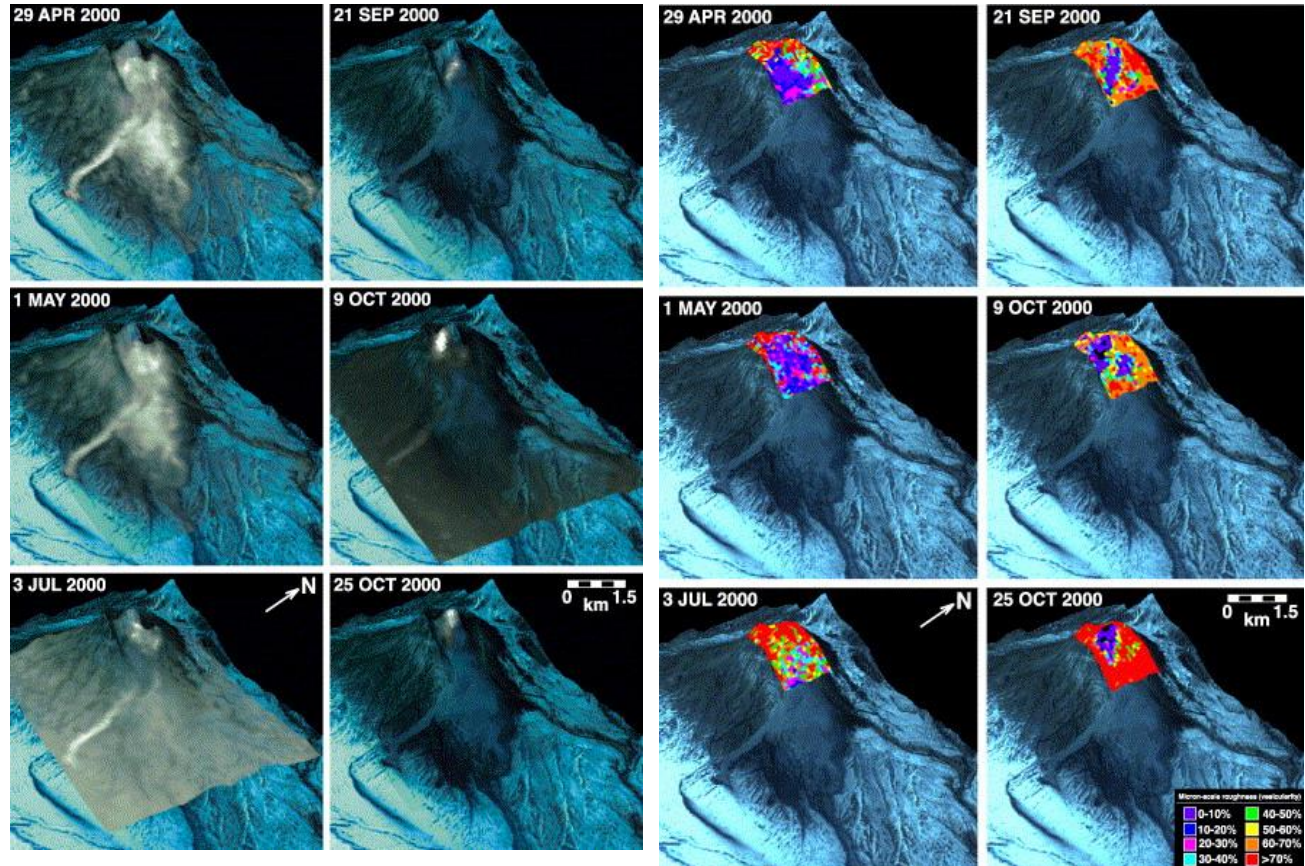
Harris, A., et al., 2018, Validation of an integrated satellite-data-driven response to an effusive crisis: the April-May 2018 eruption of Piton de la Fournaise, *Annals of Geophysics*, **61**, doi:10.4401/ag-7292.

ASTER Images of Bezymianny Eruption in 2000

ASTER data
draped over DEM
data. VNIR (left)
and TIR (right)

From ([Ramsey & Dehn](#), 2004)

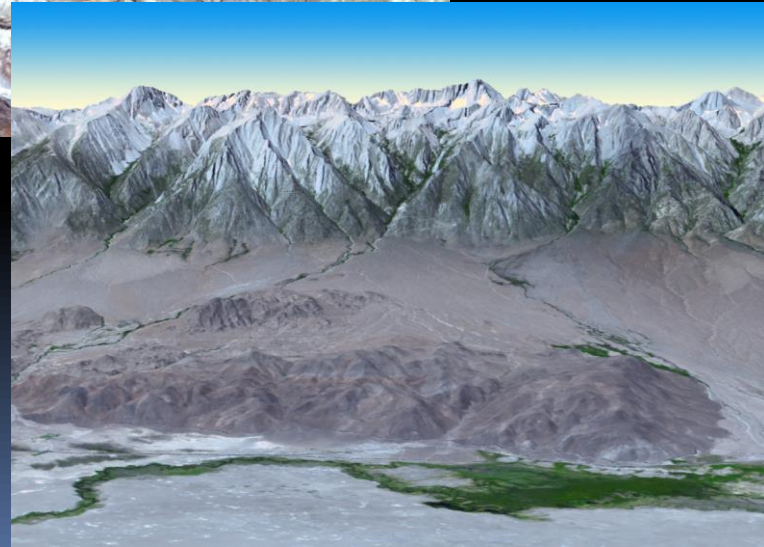
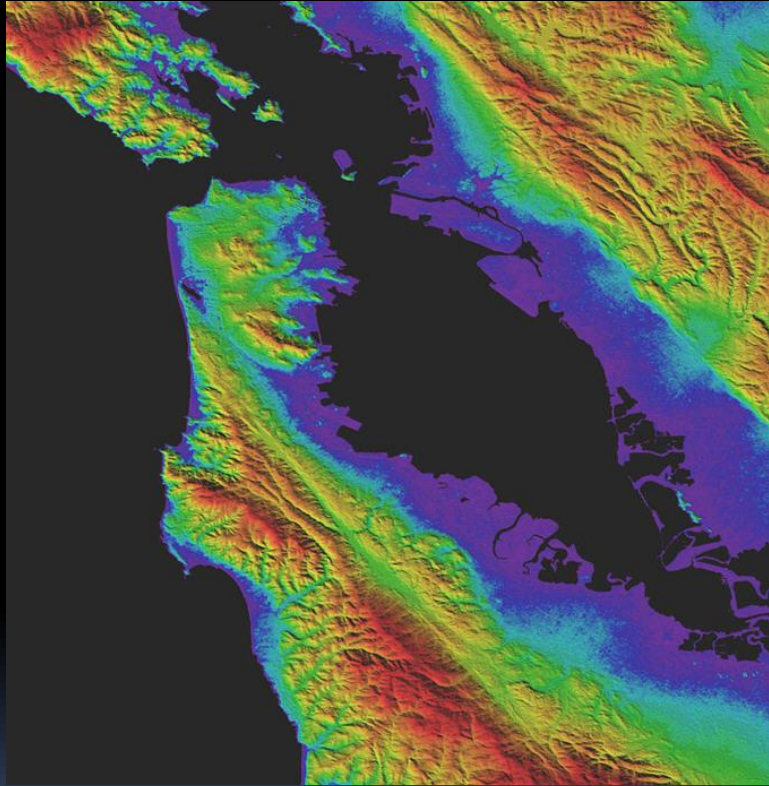
This is what you
get with the right
instrument
observing at the
right time!



ASTER Global Digital Elevation Model (GDEM)

- DEM original plan: single scene DEMs, very limited production capability, hundreds per week.
- In 2006 the ASTER Science Team in Japan proposed creating a Global DEM based on the entire archive of ASTER VNIR data. This was made possible by vastly improved and automated DEM-generation software and a mosaicking and cloud removal system.
- In 2007 the GDEM was offered by METI and NASA to the Group on Earth Observations (GEO) at the Summit of Ministers in Capetown, South Africa, and accepted as a contribution to the Global Earth Observing System of Systems (GEOSS) to serve societal needs.
- ASTER GDEM Version 2 was released October 17, 2011; ASTER GDEM Version 3 was released August 05, 2019
- **The GDEM remains the ONLY global, high resolution DEM, available free to all users.**
- The ASTER GDEM has grown to become the most distributed of all ASTER products: over 86 million files have been distributed!
- The GDEM has improved the quality of cartography in many developing countries. Other uses include visualization of earth data for scientific, commercial, educational and entertainment use.

Sample GDEM Images



Conclusion

- The ASTER instrument has had an amazing run so far
- It continues to serve its core science user communities but has also brought in new users and new ways to serve the existing users.
- TerraLook, AESICS and GDEM are but a few of the exciting developments that were never part of the original plan, but turned out to be important contributions. A Global Emissivity Data Base, continental mineral maps, and the ASTER Volcano Archive are other examples.
- Thanks for Listening!



National Aeronautics and
Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement by the United States Government or the Jet Propulsion Laboratory, California Institute of Technology.